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Cables :: "Stomata." | Phone :: 0365

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NUTRITION IN BRITISH COLONIAL TERRITORIES*

NUTRITION in British Colonial territories was discussed at a recent conference arranged by the Nutrition Society and held at the London School of Hygiene and Tropical Medicine. The Chairman, Colonel Walter Elliot, in opening the Conference, commented on the magnitude of the problem and the diversity of conditions in the various territories.

In his paper on "The Problem and the Principles Underlying its Solution," Dr. B. S. Platt gave population figures for the Colonial territories and cited examples of the variety of conditions under which these peoples live. Recent estimates of the total population of the British Colonial Empire state that it exceeds 66 million. Hong Kong with about 1½ million people in its small area, was contrasted with Nyasaland, where a population of similar size covers an area of 48,000 square miles ; these territories also illustrate the striking differences encountered, in that the former is almost entirely dependent on imported foods and the latter on subsistence agriculture.

The existence of a nutrition problem can be determined in two main ways: from clinical and related data ; and from a knowledge of the food supplies available. The prevalence of gross mal— or under-nutrition has been recorded for different territories before the War in the Report on Nutrition in the Colonial Empire (1), and there is no reason to think that the picture differs markedly now. The numbers of recorded cases of rank deficiency disease may not be large, but may well indicate the existence of widespread nutritional ill-health, single signs of which have been found to affect as much as two-thirds of some of the population samples surveyed clinically. Apathy is common and may often be associated with, if not a direct consequence of, poor feeding. Infant mortality in some territories is very high ; for example, in Hong Kong the rate is 327 per 1,000 births, and in Malta, 230 per 1,000. These rates, together with total mortality-rates and the prevalence of certain signs of inadequate nutrition, were shown in Ceylon to fall with an improvement in feeding during the period 1930-42, and after 1942 to rise again coincidentally with a deterioration in the nutritive

* Abstracted from *Nature*, 157, 557-8, 1946.

1. Nutrition in the Colonial Empire, First Report, Part II. Cmd. 6051 (London: H.M. Stationery Office, 1939).

value of the dietary. In an analysis of autopsies on 500 infants in Lagos (2), it was found that only about 3 per cent. of deaths were directly attributable to nutritional disease compared with two-thirds due to respiratory infection; it was, however, recognized that there is a relationship between malnutrition and zymotic disease.

Turning to the question of food supplies, Dr. Platt pointed out that adequate production data are lacking except for the more highly developed territories, and that so far he had obtained satisfactory data only for Malaya (pre-war) and for several West Indian territories. The problems of collecting and interpreting food consumption data relating to Colonial territories were discussed.

He then went on to show how, when the existence and nature of the problem have been determined with the help of clinical surveys and data on food consumption, it is possible to make simple, precise recommendations which, if implemented, would undoubtedly lead to improvement in the state of nutrition of the population. Recommendations of this kind have been made for the West Indian territories (3).

The methods by which a territory's dietary can be improved were discussed, emphasizing the importance of taking into consideration available and potential food supplies, whether from home production or importation. Factors involved in the improvement of food production include soil conservation and the use of fertilizers and crop residues; water for irrigation and fish culture; careful choice of crops to ensure balance and the cultivation of the most suitable varieties; efficient labour properly equipped; livestock in the right proportions to secure a balanced system of agriculture; pest control; storage, processing, transport and distribution. An outstandingly important factor in the maintenance of soil fertility is the return of crop residues to the soil. There is a strong case for limiting exports from tropical countries to products consisting entirely of carbon, hydrogen and oxygen. Dr. Platt also emphasized a difficulty which will have to be overcome in many places before progress can be made, namely, the pre-occupation of the women with time-consuming tasks. It was found, for example, in one of the Nyasaland villages surveyed that the women spent on an average seven hours a day on routine occupations, excluding special seasonal tasks and their agricultural work. It is obvious that until this burden is reduced, they will have little time to learn how they can improve their lot, let alone to put new ideas into practice. Suggestions of a simple character, involving some degree of specialization in village life, were made to show how this time expenditure might be reduced. Other equally important factors which received attention were conditions of land tenure, incentives, control of size of population, and the improvement of educational work and propaganda. Everywhere there is need for more basic facts on which to found the food policies of the territories.

The key to the solution of all these problems is suitably trained personnel. A summary was given of the various agencies involved and the steps which are being taken at the present time to assist Colonial territories in framing policies for the improvement of nutrition.

Dr. N. C. Wright in a paper dealing with the relation of animal husbandry to human nutritional needs gave figures which showed a ratio of livestock to human population greater for the Colonial territories as a whole than for the United Kingdom, for all livestock except pigs. He pointed out, however, that the distribution is very uneven, the livestock population being of high density in the predominantly pastoral areas. He put forward convincing evidence of the potentialities of native stock, the chief cause of its present inferiority being inadequate feeding. He argued that the improvement of human nutrition depends on the improvement of supplies of feeding stuffs for livestock.

The importance of relating food habits, attitudes and other matters concerning the production, distribution and consumption of food to the social structure was discussed by Dr. Richards, who successfully presented the case for the inclusion of sociologists in collecting data on nutrition as a basis for development work. In this she was supported by Prof. Firth, who opened the discussion.

Mr. A. J. Wakefield admitted the pre-occupation of Colonial departments of agriculture a few years ago with crops for export only. He stated that, from his own experience, he could endorse the importance of reorientating agricultural policies to include the nutritional needs of man.

In the general discussion, contributions were made by returned Service personnel; medical men returned from prisoner-of-war camps directed attention to the mass of material which has become available on almost every known sign of malnutrition and many new manifestations, together with data on food intake. It was also pointed out that a great deal of information has been obtained in large-scale experiments on troops and other personnel during the War. Examples were given on the administration of vitamin supplements in the treatment of ill-health. The need to utilize all this material in shaping nutrition policies was stressed. Further contributions emphasized the need for closer co-operation and co-ordination between the bodies concerned with nutrition and welfare in Colonial territories.

In summing up, Dr. Platt said he felt that the question of improving the feeding of animals could not be solved at the expense of supplies for human needs. In closing the discussion, the Chairman pointed out the need in peace, as in war, for the nations to co-operate in attacking the problems discussed at the Conference. In particular he stressed the vital importance of the use of power in various forms, which in fact amounted to a measure of industrialization.

2. Smith, E. C., *Trans. Roy. Soc. Trop. Med. and Hyg.*, 36, No. 5.
3. Platt, B. S., "Nutrition in the British West Indies" (in the press).

PEASANT AGRICULTURE

An Economic Survey on the La Pastora Land Settlement, Trinidad. May 1944-45

BY

A. L. JOLLY

(*Lecturer in Economics, Imperial College of Tropical Agriculture*)

PART II

Cress Growers

The most distinctive type of farmer at La Pastora was the water cress (*Wasturtum officinale*) grower; these farmers have been defined as any deriving more than 50 per cent. of their agricultural income from cress or having more than 3,000 square feet of bed area. Nine farmers were included by this definition; six other farmers had some cress beds usually a few hundred square feet and these farmers were excluded. The average area of cress beds of the nine growers (*i.e.* excluding dividing bunds, paths and waste round the beds) was 5,100 square feet; the total area required for these beds naturally varied with their layout but on the average a quarter of an acre could accommodate 5,000 square feet of bed area. This area would yield an income of from $350 to $700 per annum according to the success of the cultivation.

Cress is in many ways an ideal crop for peasants on very small holdings. The value output per acre can be five to ten times the output of other crops; the crop gives continuous revenue and continuous employment throughout the year. The relatively high value of the produce obtained from one cutting and its small bulk make marketing difficulties less acute than with other crops. The land has to be maintained in a cleaner and more fertile state than is necessary with many other crops. The only disadvantage of cress as a crop is that it requires special culture and knowledge and there is the danger that the successful grower may concentrate his attention on this one crop to the exclusion of others.

The cress beds were situated along the stream that runs through the settlement and on all but one farm irrigation was by natural gravity. More water is required under tropical conditions than in a temperate climate but little trouble was experienced at La Pastora through inadequate water supply. The high sun temperatures were successfully mitigated by one progressive grower who planted banana shade on the bunds between the beds; this practice recommends itself since there is no chance of banana leaves falling unobserved into the beds. The problem of water supply was much more in respect of flooding; the stream rose rapidly after heavy showers and it was difficult, on many beds, to divert the swift running turbid water. A flood may damage a bed by breaking the bunds, carrying away plants or silting them up.

In a well-managed "cresselege" the beds were well away from any roads (to avoid dust), they were kept scrupulously clean as to water and weeds and always fully planted. To achieve these conditions several operations were carried on more or less continuously: (1) manure was applied in small doses periodically; cattle manure in a dry well rotted condition was exclusively applied either after every cutting (every six weeks on productive beds), or after every other cutting. (2) Hand picking of "conchs" was a painstaking and never ending task; "conchs" are snails (*Planorbis*) which appeared to be about the only, although serious, pest of the cress; under the congenial conditions of the cress beds these mollusces multiply rapidly and by feeding on the crop soon destroy a bed if not controlled. (3) Supplying of plants was necessary to a varying extent; some plant casualties occurred on the best beds either from the ravages of the "conch", from flooding or by pulling at harvesting. (4) Some weeding was generally necessary particularly where weak patches developed.

It can be realised that for a peasant the successful management of every bed of a "cresselege" is no simple matter; the minimum requirement is continuous and methodical work. The income from various "cresseleges" reflected on the variability of success this cultivation may entail: the highest output was obtained by one very efficient and reliable grower who had grown cress previous to taking a settlement holding and who achieved the exceptional output of $15.60 per 100 sq. feet bed area per annum; the lowest was $1.62 while the general run of reasonably efficient growers was $5-7 per 100 sq. feet per annum. The estimated wastage was higher for cress (.24 cents per $1.00 revenue) than any other crop; wastage was due to loss of crop by damage to beds and not to unsaleability.

Table 7

Agricultural Income of Cress Growers compared with all Farms, ($ per Holding)

	Cress Growers	All
Water Cress	466	109
Vegetables	371	162
Grains	10	5
Starchy Roots	79	109
Tree Crops	49	59
Livestock	104	119
Livestock Products	165	128
Total Agricultural Income	1,244	691

These nine cress growers were the backbone of the settlement; although they farmed only 20 per cent. of the land surveyed they produced 37 per cent. of the total agricultural income. Their cress was not however grown to the exclusion of other crops and livestock; they had no more than the average amount of land under cultivation and yet raised about two and a half times the vegetable crop of the average; their output of other crops was lower but their crop income *exclusive of cress* was about one and a half times the average. As to livestock, four of the nine farmers would qualify as livestock farmers (over 3 cattle units per holding); on the average they owned about twice as many livestock as the average of all settlers. Their sales of stock and livestock products were little higher than the average but were $64, about one-third, higher, when changes in valuations were taken into account. At present, therefore, there can be little fear of cress farmers becoming unduly dependent on a one-crop type of farming.

The high agricultural income of cress farmers entailed high expenditure: the expenditure of these farmers was more than double the average and amounted in total to 44 per cent. of all agricultural expenditure by the 44 farmers surveyed. More than half this heavy expenditure was for labour which was almost three times the average. The labour expenditure by cress growers of $328 per holding is the equivalent of about one man full time throughout the year. The total labour input, charging available family labour at $1.00 per day, was $653 compared with an average of $370. Nevertheless, the labour efficiency of the cress growers was good; the income per $1.00 input of hired and family labour was $1.95 compared with an average of $1.85.

Table 8

Agricultural Expenditure of Cress Growers compared with all Farms, ($ per Holding)

	Cress Growers	All
Labour	328	130
Manure	54	15
Seed	20	10
Feeding Stuffs	29	39
Agricultural Supplies	9	4
Rent	49	45
Miscellaneous	20	10
Total Agricultural Expenditure ..	509	253

These cress growers gave an interesting side-light on labour as employed by peasant farmers. It has appeared in this and previous surveys that the relatively small earnings of peasants were often unduly diminished by the payment of wages. It is true of course that many crops require more labour at planting and harvesting than the peasant and his family can supply, but it would seem that often undue wage expenditure was involved. The cress growers made the impression that the employment of labour stimulated the farmer to better management and, when he was working with his men, to better work himself. All cress farmers worked with their labourers and one felt that the sense of proprietorship and the fact that the farmer wanted to show an example to the workers led to better work all round. The results of good work led to a standard of enthusiasm and technical competence higher than usually found with a farmer working alone.

It can be seen from Table 8 that the cress growers' expenditure on manure was far higher than the average. Seventy per cent. of all manure applied in controlled quantities was applied by the nine cress growers; 80 per cent. of this expenditure was for pen manure and 20 per cent. for Sulphate of Ammonia (not used on cress beds). Every cress farmer used pen manure and only one used none on his beds; the applications to the cress beds ranged as high as 1 ton 8 cwt. per 100 sq. feet per annum (which included starting some beds) and averaged about 10 cwt. per 100 sq. feet. Allowing the "cresselege" to occupy double the actual bed area this application amounts to 110 tons per acre per annum.

As a result of this generally heavy expenditure the net agricultural income of cress growers was not the highest of any group. (*See* next Section). The net agricultural income was, however, $313 per holding and $0.46 per man-day available higher than the average of all farms. Cress farmers derived a high proportion of their total income from their holdings (72 per cent.) and had the greatest number of man-days available (304) of any group. They had larger families (4.12 consumer equivalents) and supported more non-workers. They nevertheless maintained a good standard of living, their total personal expenditure being $173 per consumer equivalent per annum compared with an average of $168.

The prosperous condition of the cress growers has been achieved more by hard work than by special circumstances or outside help. Their initial capital was only $60 higher than the average and they had been on their farms about the average length of time, so had no particular advantage in selecting their holdings. Their only natural advantage seemed to be in the matter of age of proprietor; they were the youngest group, 7 years below average.

Indeed, the progress made by these farmers should be attributed to their enterprise and to the fact that a properly managed "cresselege" of 4,000-5,000 square feet can provide steady employment and a profitable income about which a well cultivated and well stocked holding can be built.

Livestock Farmers

Livestock farmers were defined as those having an average of more than 3 cattle units of all kinds throughout the year, who had not already been classed as cress farmers. Six settlers conformed with this definition. The group was the most

prosperous of any, having a total income of $3.10 per total man-day (average $1.87, cress farmers $2.69); their net agricultural income was $4.64 per man-day available or $2.86 and $1.37 *higher* than the average and cress farmers respectively. These figures were somewhat exaggerated by the fact that one farmer sold out a large amount of stock during the year but, even allowing for changes in livestock valuations, livestock farmers earned a net agricultural income of $3.12 per man day available. Such earnings are exceptionally high for peasants even in times when agricultural labourers can earn $1.20 per day.

The average number of livestock on these six farms was 4.47 cattle units per holding or about two and a half times the average of all farms. This population was apparently distributed over various classes of stock in a way surprisingly similar to the average (Table 9); livestock farmers had a rather larger proportion of pigs and a rather smaller proportion of poultry than the average.

Table 9

Composition of Livestock Populations

% of Total Cattle Units Represented by:	Livestock Farms	All
Draft Animals	11	9
Cattle	42	48
Goats	8	9
Pigs	29	16
Poultry	10	18

These percentages for the whole six farms were however misleading; individual farms usually did not approximate to the average; one farm had an exceptionally large proportion of draft animals (50 per cent. of the total cattle units), two of cattle (90 per cent.) and two of pigs (60 per cent.). Only one farm had approximately average distribution of stock. Individual farmers, therefore, were more in the nature of specialists in one type of stock than all round livestock farmers. Such wide variation between so few individuals does not make a description and comparison of methods of livestock management feasible.

The high total income of these farmers was derived more from the holding (75 per cent.) and less from outside employment than in any other group. Livestock sales and sales of products naturally contributed more to the agricultural income than the average; livestock income was no less than $1,052 per holding or 68 per cent. of the total agricultural; the livestock income on all farms averaged less than a quarter of this figure and contributed only 37 per cent. of the total. Livestock income per cattle unit was nearly twice as high on the livestock farms ($236 per cattle unit) as the average ($146). These figures, however, rather exaggerate the efficiency of management on the livestock farms since these farms made capital sales and spent a large amount on feeding stuffs. The net livestock earnings on the livestock farms was $109 compared with an average of $84, showing a smaller but definite superiority of efficiency on these six farms.

Table 10

Agricultural Income of Livestock compared with all Farms ($ per Holding)

	Livestock Farms	All
Cress	36	109
Vegetables	88	162
Grains	6	5
Starchy Roots	298	109
Tree Crops	73	59
Livestock	542	119
Livestock Products	510	128
Total Agricultural Income	1,553	691

Good livestock farming should be an aid to and be accompanied by good crop farming. The livestock farmers were superior in this respect in having a crop income of $501 per holding compared with an average of $444. The difference was not however great enough to demonstrate any great advantage in a combination of crop and stock farming. The fact was that livestock farmers did not concentrate on the intensive vegetable crops which would have given them a high return on pen manure applied; they concentrated on the less responsive crops (starchy roots and tree crop in a mixed stand) which also required little labour. These crops, besides being labour saving also provided a considerable supply of waste green meat for animals. The output of starchy roots and tree crops was more than double the average and $70 per holding more than farms on which these crops were the main source of income ("Old System"). The production of these crops on the livestock farms therefore seemed to be at a high standard but the nature of the crops made it impossible to increase the crop income to anything like the level achieved by cress growers.

Thus, it would appear that livestock farms even with an average of only 4½ cattle units were overstocked for the maximum benefits of mixed farming to be obtained. With this density of livestock heavy purchases of feeding stuffs were necessary (Table 11) and the farmer had little time to attend to the more intensive crops. (The feeding stuffs expenditure was $31 per cattle unit on livestock farms compared with an average of $23, in spite of the short supplies and unofficial rationing whereby large purchases by one buyer were not permitted). Furthermore, livestock farmers appeared unwilling (ample income was available) to employ labour in tending stock. Livestock farmers actually spent considerably less on wages than the average, presumably because there was little scope for hired labour on the chief crops grown. The difficulty of employing labour in tending stock is that a hired man could be most

useful in taking full responsibility at certain periods of the year when careful work and supervision on high grade vegetables was in progress; labour for stock would be of little advantage in merely assisting the farmer. With the alleged unreliability of unsupervised paid labour and the considerable investment represented by the livestock, livestock farmers preferred to tend the animals themselves and grow the simplest crops.

Table 11

Agricultural Expenditure of Livestock Farmers compared with All ($ per Holding)

	Livestock	All
Labour	99	130
Manure	4	15
Seed	3	10
Feeding Stuffs	138	39
Agricultural Supplies ..	2	4
Rent	48	45
Miscellaneous	11	10
Total Agricultural Expenditure ..	305	253

The simple method of crop farming was reflected in the expenditure on manure; the expenditure of $4 per holding represented the amount of manure applied in controlled quantities; strange to say only about half of this manure was produced on the holdings, the other half being purchased by livestock farmers with cress beds but no cattle. It is obvious then that the bulk of the manure produced (probably five times the amount recorded in expenditure) was disposed of indiscriminately in the plantations of starch roots and tree crops.

The very moderate total expenditure accounted in part for the high net agricultural income. The gross agricultural income was about $300 greater than that of the cress growers but the expenditure was $200 less, giving the livestock farmers a net agricultural income of $500 more per holding than cress growers.

A most striking feature of the livestock farmers was their large capital. The initial capital with which they entered their holdings (exclusive of any livestock brought on to the holding) averaged $537 compared with an average of $316, and an average for cress farmers (the next highest) of $370. The valuation of livestock at the end of the survey year was $727 for livestock farmers, average $241, cress growers $376. Indeed, the livestock farmers were the capitalists of the settlement; the weakness of the application of their relatively large resources was that it was invested unduly in one channel, (85 per cent. of total valuations livestock). This narrow channel of investment led to relatively low returns per $1.00 invested (Table 12). Had less funds been invested in stock and more in labour for high quality vegetables and cress (assuming the problem of supervision could be satisfactorily solved) it is probable the total income and the return on capital would have been higher.

Table 12

Income per $1.00 of Total Valuations on Livestock and All Farms

	Livestock Farms		All
	Gross	Adjusted for changes in Livestock Valuations	
Total Income ..	$2.40	$1.90	$3.80
Agricultural Income ..	$1.80	$1.30	$2.40
Net Agricultural Income	$1.45	$0.95	$1.50

"Old System" Farmers

This group of farmers, named "old system" from a phrase coined by one of them, derived most of their agricultural income from starchy roots and tree crops. There were twelve farms not included in previous groups on which these two crops comprised more than 50 per cent. of the agricultural income.

The "system" consisted of planting the bulk of the holding in plantains (with a few "figs" and bananas) underplanted with starchy roots; cassava and tannia were sometimes planted in small pure stands, but the usual practice of these farmers was to have a mixed and somewhat variable stand throughout. In damp spots eddo were planted; these plants were often put in the bottom of a natural or artificial drain; they retarded erosion in the rainy season and appeared to thrive on the silt they retained. On the drier sections tannia and cassava occurred more frequently. This cropping was in the nature of a permanent cultivation: whenever a starchy root was harvested a cutting from the old plant would be set to replace it. Any surplus green stuff (such as plantain stems) would be chopped into small pieces and left to rot on the ground. The only upkeep operations required for this type of cultivation were some cutlassing and the removal and transplanting of plantain suckers. A well covered plot under this "system" gave the appearance of luxuriant growth but, also, on first acquaintance, of complete lack of system. It was favoured most by Spanish and West Indians; only two East Indians were included in the group.

One would expect this type of farming to be an extensive one, low output and low input being characteristic. It is true that the agricultural income was only about two-thirds of the average (Table 13) and less than half that of the two groups already discussed; but the low income was due to the small extent of livestock enterprises as much as the low output of crops; the crop income per cultivated acre ($172) was not very much less than the average ($216), but livestock income on old system farms was less than half the average on all farms. The low livestock income was due to the small number of livestock kept (.61 cattle units per holding). It would appear therefore that a

fully planted and well maintained holding under the "old system" can give a fair return per acre and certainly a better return than a holding suffering numerous vegetable crop failures (*see* Table 17 and context).

Table 13

Income of "Old System" compared with All Farms ($ per Holding)

	Old System	All
Cress	24	109
Vegetables	68	162
Grains	2	5
Starchy Roots	122	109
Tree Crops	116	59
Livestock	53	119
Livestock Products	43	128
Total Agricultural Income	428	691
Wages from Peasants ..	20	10
Wages from Estates ..	7	20
Non-Agricultural Employment	264	163
Profits from Business ..	227	218
Total Income	946	1,102

One advantage that this system had for an incoming tenant was that it involved the minimum of expenditure to operate. The agricultural expenditure of the farms under this system was the lowest of any group and was $117 less per holding or 50 per cent. less than the general average. Economies were effected under all heads (except rent) and particularly as regards labour; the economy in feeding stuffs was roughly proportional to the number of animals kept. This overall economy was made possible by the system; from the crop income there was no evidence of under-cultivation within the requirements of the system.

The system can be worked at very low capitalisation as well as low operational costs. The valuations at the end of the year were far lower ($86 per holding) than the average ($291) of any other group. Thus, in a number of cases where finances were difficult the "old system" was the only one under which a settler could take up farming.

Table 14

Agricultural Expenditure of "Old System" Farms compared with All Farms ($ per Holding)

	Old System	All
Labour	56	130
Manure	5	15
Seed	10	10
Feeding Stuffs	12	39
Agricultural Supplies ..	1	4
Rent	47	45
Miscellaneous	5	10
Total	136	253

The simple cultural requirements combined with the small number of livestock on these holdings left the farmer comparatively free to take work away from his holding. The number of man-days he had available for his holding was 223 (compared with an average of 240), and this represented only one-third of his working time and that of his family; on the average, on all farms two-fifths of the time was available for work on the holding. As a result the earnings of the old system farmer away from his holding were $100 higher than the average and comprised 55 per cent. of his total income.

The economy in family labour on the old system holding resulted in the net agricultural income of this group being only $0.40 per day available lower than the average. These figures underestimate the farmers' earnings because a large amount of planting was still being undertaken during the survey year and being a permanent cultivation this planting respresented capital appreciation; there were also, contrary to the average, small appreciations in livestock values and valuations of buildings and equipment. Taking capital values into account, it can be seen from Table 15 that the Net Agricultural Earnings of the old system farmers were actually slightly above average.

Table 15

Man-Power and Earnings of "Old System" compared with All Farms

	Old System	All Farms
Man-days available for Holding	223	240
% Total Man-days available ..	32	41
Net Agricultural Income per Man-day available	$1.32	$1.78
Net Agricultural Earnings per Man-day available	$2.19	$2.13

The chief economic strength of this system of farming is elasticity. It is elastic as to time and rate of initial planting in that it is unnecessary to clear the bulk of the land (as when cress or vegetables are grown) to start production. With limited capital for subsistence and the employment of labour, this latitude is a great asset. The system is elastic as to the few cultural operations; these operations are not exacting as to season and can therefore be spread a little at a time over most of the year or to suit the convenience of wage work off the holding.

Finally, and very important, the system is elastic as to the harvesting of the crops. Many starchy roots can remain in the ground for up to three months after maturity without much deterioration; plantains are not picked ripe in the sense that bananas are, and can be harvested within a period of a month; the safe ripening margin for saleable bananas (few of which were grown) is about one week. This latitude naturally eases the labour requirements for the harvesting operations, but it is far more important from the

point of view of marketing. The "marchands" are in a very strong buying position with many vegetable crops, large quantities of which must be disposed of within a week or two; not so with old system farmers, who can hold their produce back for a month or more without serious loss.

Indeed, the old system, although it appears agriculturally crude, was a sound way for a small man to take up farming at La Pastora. It gave him an opportunity of making good earnings for time put into his holding, while leaving him free to augment an inadequate income by outside work. It is to be hoped that as the farmer becomes more firmly established he will gradually introduce other crops and increase his livestock so that he may raise his standards and have to depend less on outside earnings; many old system farmers expressed a desire to try small patches of vegetable crops, but were wise enough not to do so until they had sufficient funds to insure good cultivation of the crop.

The only objection to the system as a stepping stone from labourer to farmer seems to be in respect of the maintenance of fertility. It is possible that the vegetable refuse left to rot on the land may be insufficient to maintain the fertility so that when vegetable cultivation is attempted, it will not prosper. This objection appears less serious when it is remembered that successful vegetable cultivation in Trinidad must depend on heavy manuring; what appears to be more serious is that the fertility may not remain high enough to maintain a good stand of plantain and starchy roots; if an old system stand once fails, the land rapidly depreciates to a derelict condition. Thus the maintenance of fertility under the old system is important and merits study.

Low Earnings

The previous three groups of farmers can be considered successful. Their earnings varied but they appeared to be farming as successfully as their particular conditions and capabilities allowed. The remaining two groups, comprising seventeen farmers, do not apparently farm successfully.

The farmers with low earnings (7 in number) were defined as those with gross agricultural earnings (*i.e.* taking account of capital changes) of less than $300 per annum; the average earnings were only $169 compared with $806 for all farms. In such a group of farmers the questionnaires were naturally more suspect than others but these seven farmers have been included after a careful scrutiny of their answers. It is probable, in any case, that omissions from income were more likely to occur in non-agricultural than in the agricultural income; the surveyor saw the state of cultivation at the interview and thus had some visual check on the answers; whereas some sources of outside income, such as gifts from friends, consumption of initial capital etc., were difficult to check and some of them the farmer might wish to conceal.

The agriculturally poor condition of these holdings was illustrated by the fact that the crop income (which made up 80 per cent. of the total agricultural income) was only $67 per cultivated acre or only one-third of the average, notwithstanding the fact that the group had the smallest area (1.87 acres) under cultivation of any group; the net agricultural income was only $0.08 per man-day available for holding work. It can be seen from Table 16 that the composition of the agricultural income did not vary materially from the average; the absence of cress would of course tend to depress the income, but the correspondingly higher proportion of starchy roots and tree crops need not have that effect (*see* "Old System" Farmers).

Table 16

Agricultural Income of Low Earnings compared with All Farms

	Low Earnings		All	
	$ per Holding	% of Total	$ per Holding	% of Total
Cress	—	—	109	16
Vegetables ..	44	28	162	23
Grains	9	6	5	1
Starchy Roots ..	48	30	109	16
Tree Crops ..	25	16	59	9
Livestock ..	19	12	119	17
Livestock Products	12	8	128	18
Total Agricultural Income	157	100	691	100

A feature of the income not shown in the Table is the amount of produce wasted; wastage of all but cress consisted of produce unsold, chiefly because "marchands" were unwilling to buy at the time the produce was ready for sale; losses on water cress were due to damage to beds. The wastage of crops other than water cress averaged .06 cents per $1.00 output for all farms. The Low Earnings farmers had a wastage rate of .16 cents for all crops and as high as .51 cents in the $1.00 for vegetables. These rates were even higher than indicated because these farmers also fed vegetables to livestock; such feeding was really disposal of unsaleable produce. On all farms the rate of feeding vegetables to stock was .03 cents per $1.00 income; on the low earnings farms the rate was .19 cents. Thus, for every $1.00 worth of cash sales of vegetables on the low earnings farms there was another .95 cents worth (valued at low prices) of produce that was unsaleable.

Farmers complained that the market was glutted at the time the crops were ripe and that the "marchands" always asked for produce they had not got and would not accept what they had. These marketing difficulties were no doubt largely due to the fact that the "marchands" found the Low Earnings farmers were not the most

convenient type to buy from; these farmers usually had small and erratic supplies to offer, usually at times when there was an abundance of that type of produce. The "marchands" naturally gave preference to their more reliable and enterprising producers and often visited low income farmers merely in the hope of finding unusual out-of-season crops.

The surprising feature of the agricultural expenditure (Table 17) was the high expenditure on labour. The figure is not high absolutely, but considering the low income, it was surprising that any labour was employed at all. There were 10 farms in other groups that employed no labour at all, and yet achieved an agricultural income of $380 or two and a half times the Low Earnings group. The average income per $1.00 spent on wages was $5.20 for all farms; on the Low Earnings farms it was $3.10. Much of the labour in the Low Earnings group was for unproductive purposes; with the general poor state of cultivation and the relatively large area uncultivated, a large amount of cutlassing was necessary; these farmers did not usually carry out cutlassing as a routine but allowed the growth to become so dense that by the time the supervisor threatened ejectment the work was beyond the powers of the farmer and his family.

Table 17

Agricultural Expenditure of Low Earnings compared with all Farms, ($ per holding)

	Low Earnings	All Farms
Labour	47	130
Manure	2	15
Seed	7	10
Feeding Stuffs	44	39
Agricultural Supplies ..	2	4
Rent	37	45
Miscellaneous	2	10
Total Agricultural Expenditure	141	253

The poor standard of farming of these seven settlers was not due to their time being occupied in outside employment. Although the number of man-days available (194) was less than the average (240), these days made up a proportion of the total very similar to the average (40 and 41 per cent. respectively).

The conclusion must therefore be drawn that these farmers were more interested in an easy life than a good standard of living or a well cultivated farm. Many characteristics of the family also point to this conclusion. They were generally middle aged men (average 44 years) with few responsibilities: they had an average of only 0.8 children (0.3 consumer equivalents) dependent on them compared with 2.1 on the average. Two of the seven Low Earnings farmers were single men with no families; there were only five such farmers among the whole 44. Three of the seven farmers said they had taken the holding because of the house; only six farmers in the 44 gave this reply.

It is difficult to know what to do with these Low Earnings settlers now they are established in their holdings; but it is obvious that all precautions should be taken to guard against introducing similar candidates on other settlements.

Vegetable Farmers

The remaining 10 farms were expected to form a heterogeneous group and were originally labelled "Mixed". On analysis, however, it was found that the group was far more uniform than expected and was characterised by a large proportion of the income being derived from vegetables; 59 per cent. of the agricultural income of these 10 farms or 73 per cent. of the crop income was derived from vegetables; the corresponding averages for all farms were 23 and 37 per cent. respectively. Only three of the ten farms had vegetable incomes representing less than 50 per cent. of the total agricultural, and only one farm less than 50 per cent. (45%) of the crop income. These farms therefore form a quite distinct group worthy of analysis and it appears that the classification as a whole has included all the main types of farming at La Pastora. The label "vegetable" farmers does not, of course, imply that these farmers were necessarily experienced or successful vegetable growers. They were, in fact, far less successful than cress farmers in growing vegetables.

Table 18

Agricultural Income of Vegetable compared with All Farmers, ($ per Holding)

	Vegetable Farmers	All
Cress	11	109
Vegetables	214	162
Grains	2	5
Starchy Roots	48	109
Tree Crops	16	59
Livestock	27	119
Livestock Products ..	48	128
Total Agricultural Income ..	366	691

The agricultural income of the Vegetable Farms is given in Table 18 and it can be seen most clearly that all crops and stock output was made subordinate to vegetable cultivation. The agricultural income, excluding vegetables, was only $152 per holding compared with an average for all farms of $529: in spite of this policy, on Vegetable Farms the income from vegetables was not exceptionally high and was little more than half the vegetable output on cress farms ($371 per holding).

The two reasons for the mediocre output of vegetables on these ten farms were the type of vegetable grown and wastage. Practically every farmer raised pumpkin or cucumber or both;

these crops cover a considerable area and do not yield a high income per square yard; they are also associated with bare unweeded land, because cutlassing and hoeing during the growing season are difficult without damaging the plants. Wastage occurred with the more intensive crops (lettuce, tomato, cabbage, etc.); the wastage on vegetable farms was about .10 cents per $1.00 output of all vegetables compared with only .02 cents among the cress growers. The result was that the agricultural income of these vegetable farmers was only about one-half of the general average, and only double the very low figure for the Low Earnings group.

The agricultural expenditure of these farmers was unexpectedly low; this fact is noticeable, not so much in view of the absolute economy, as in view of the type of farming these settlers were trying to practise. The economies which seemed false (even if necessary) were in respect of manure and labour. Economy on manure was of course a small item financially, but it illustrated the low standard at which vegetables were cultivated; the expenditure on manure by cress farmers excluding applications to cress beds was about $25 per holding or almost three times that of the vegetable farmers.

Table 19

Agricultural Expenditure of Vegetable compared with All Farmers ($ per Holding)

	Vegetable Farmers	All
Labour	115	130
Manure	9	15
Seed	10	10
Feeding Stuffs	17	39
Agricultural Supplies ..	5	4
Rent	41	45
Miscellaneous	11	10
Total Agricultural Expenditure	208	253

A comparison of expenditure for labour on vegetables and all farms hardly emphasises strongly enough the deficiency in labour input on these ten farms. Nineteen farmers (low earnings and "old system") were run on systems that made labour economy possible or desirable; the remaining farms (cress and livestock) spent $240 per holding on labour; it seems likely therefore that a vegetable farmer should spend $200-$300 on wages, or twice as much as they actually did, to make the cultivation a success.

The economy in paid labour was not offset by ample family labour; there were actually slightly fewer man-days (218) available on Vegetable Farms than the average (240). Charging family labour at $1.00 per man-day available the labour input on Vegetable Farms was $333 compared with an average of $370 for all farms and $653 for cress growers. The family labour situation was difficult because there were fewer workers (1.56 consumer equivalents) than the average (2.07 consumer equivalents), and an equal number of dependents, so that the wife's time was occupied mainly in household duties. To combat these difficulties the farmer spent a larger proportion of his time on his holding (52 per cent.) than the average (41 per cent.) or than any group, and as a result his earnings off the holding were only $187 compared with an average for all of $411.

The combination of low income on and off the holding lead to a low standard of living and low rate of earnings among the vegetable farmers. The total personal expenditure per consumer equivalent was only $131, which was lower than any group and lower even than the Low Earnings group ($168 per consumer equivalent). The Vegetable Farmer's Total Income per Total Man-day was $1.31, about the same as the "old system" farmers, but his Net Agricultural Earnings were only $1.68 compared for instance with $2.19 of the "old system" farmers.

The results obtained by these vegetable farmers must therefore be considered unsatisfactory; their earnings were low and particularly low when account is taken of the cropping system which should give scope for earnings comparable with those of Cress Growers. It appears that vegetable farmers were attempting to grow crops for which they were not fitted. One undoubted deficiency was in respect of capital which partly accounts for low employment of labour; the initial capital of the vegetable farmers averaged $300 or about the same as the "old system" farmers compared with $370 for cress growers and $537 for livestock farmers. It would seem that initial capital of $400--500 is essential for successful vegetable growing on this scale, in order to pay adequate hired labour and to finance crop failures and unsold surpluses which appear to be a certainty with the beginner.

It is suggested that, under conditions, similar to La Pastora, a system of farming based on a large proportion of vegetable crops is a very unsuitable organisation for any but the well financed and experienced peasant; the rich and experienced farmers are of course in a position to make very high earnings, but the system has disadvantages for the ordinary peasant which are perhaps worthy of discussion. A vegetable farm does not furnish a regular income; not only is the income high in the dry season and low in the wet, but it varies widely from week to week. This variability is associated with (but does not coincide with) variability in expenditure, chiefly for labour. An ordinary peasant working on a narrow financial margin and keeping no books has, therefore, the greatest difficulty to have "shop money" on hand throughout the year, let alone money for wages when required. If the peasant depends largely on vegetables, he cannot earn a regular small income off his holding because successful vegetable cultivation requires constant attention, if not actually continuous labour, throughout the year.

Many of the intensive vegetables are very speculative crops; they deteriorate rapidly when ripe, resulting in temporary gluts on the market. These marketing difficulties were particularly acute at La Pastora because few farmers could market their produce themselves in Port-of-Spain or San Juan. It was common therefore for some producers for instance to receive as much as 24 cents per lb. for tomatoes while others were unable to sell them at any price. Lettuces, because of their rapid deterioration in the field, are almost as bad as tomatoes; cabbage and melongene are not quite so difficult but obviously do not allow anything like the same latitude as plantains and starchy roots.

The speculative nature of most vegetable crops could be minimised by growing a wider variety of crops and by practising successive plantings; but these steps bring their own problems. First, when intermediary marketing agents are involved, the small lots of crops offered for sale may be ignored by the traffickers in favour of larger purchases. Second, that a farmer, by multiplying his crops, is multiplying his agricultural difficulties in proportion to the number of crops and not the acreage grown. The capabilities of a peasant are taxed in raising one or two main vegetable crops; it can be imagined that he could never cope with say five crops each at three different plantings.

The only other alternative is the formation of a Co-operative Marketing Society, by which means farmers could cultivate reasonably large areas of individual vegetable crops without being dependent on the unreliable "marchand". Indeed, La Pastora appears to offer an outstanding opportunity of demonstrating the value of Co-operative Marketing.

MANILA GRASS FOR TROPICAL LAWNS *

Zoysia Matrella Merr., or Manila grass, was first introduced into Puerto Rico in 1936 when a half square block of the sod was received from the Florida Agricultural Experiment Station. From this original introduction, it has been propagated on the station grounds until it now covers about 5 acres. The grass has proved definitely superior to such lawn grasses as centipede (*Eremochloa ophiuroides* (Munro) Hack.), St. Augustine (*Stenotathrum secundatum* (Walt.) Kuntze., Bermuda (*Cynodon Dactylon* (L.) Pers.), Java (*Polytrias* praemorsa Hack.), and carpet (*Axonopus compressus* (Swartz.) Beauv.). Manila grass is chiefly a tropical and subtropical grass, but it can be grown, according to the literature, as far north as Connecticut. Blades are short, tough, narrow, numerous, pointed, and dark green. The important advantages of Manila grass are that it crowds out most weeds and other grasses, remains green during hot dry weather, and appears to have no important insect pests and diseases. The grass grows well under moderate shade even when in competition with the trees for water and nutrients. It also will grow satisfactorily under trees of dense shade, such as the mango, provided the lower limbs are pruned to 10 feet or more above the ground. The flower stocks appear mostly during the winter months in Puerto Rico but being short they are not particularly objectionable and can be cut with a rotary lawn mower.

Well-established Manila grass forms a mat which feels like a thick rug under foot. The blades will endure considerable punishment from wheel or foot wear and for this reason the grass serves well on playgrounds and such areas which receive considerable trespassing. Unfortunately, this toughness makes the grass hard to cut with a hand lawn mower, but a rotary power mower cuts it easily.

As yet there is no known commercial source of Manila grass seed in the western hemisphere. Hence, propagation is done entirely by sod blocks or sprigs, which are somewhat more tedious to handle and slow to establish as compared with seeding. A Manila grass lawn can be established in Puerto Rico in 9 to 20 months, depending upon the soil fertility, the water supply, and the original planting distance between the sod blocks. The blocks can be transplanted with a high percentage survival when the usual precautions are taken. Although no cost figures are available for comparison with other grasses, it has been generally observed at this station that Manila grass lawns once established, are economical to maintain because of relatively less need for mowing and weeding.

*Puerto Rico Experiment Station of the Office Experiment Stations U.S.D.A., Mayaguez, Puerto Rico. *Rept. Fed. Exp. Stat.* for period October-December, 1945.

CRUMB CONTENTS OF SOILS

Estimations of crumb contents confirmed that at Serere, Uganda, no increase in crumb percentage resulted from applications of farmyard manure. The operation of digging-in a green legume definitely reduced the crumbs. Crumb regeneration of soils, resting under various species of grasses, was investigated at Kawanda, and a number of species were found to be effective soil improvers. There were indications that "sticky-point" determination of soils might provide a measure of their relative crumb-structure potentials. Analyses of crumb content of virgin soils may in time permit of a table being drawn up of optimum crumb percentages of all the soils in the Protectorate, on which advisory work on grass rotations could be based.—(*Ann. Rept. Dept.* of *Agr.*, Uganda, 1944).

THE SUGAR INDUSTRY OF FIJI

BY

C. Y. SHEPHARD

(Carnegie Professor of Economics, Imperial College of Tropical Agriculture)

(The present article consists of Part I of Dr. Shephard's report on the Sugar Industry of Fiji, with some minor omissions and additions. For particulars of the dispute (Part II) between the cane-farmers and the Colonial Sugar Refining Company which Dr. Shephard went to investigate and of his recommendations (Part III) the reader is referred to the Fiji report, Colonial No. 188 of 1945, obtainable from H.M.S.O. London, price 1/- net. The Report contains additional tables and various explanatory statements.)

The Sugar Industry

The sugar industry of Fiji is young in comparison with that of the British West Indies where sugar has been a staple crop for over 300 years. The first sugar mill in Fiji was erected in the early 1870's in the neighbourhood now occupied by Suva. Other mills were soon afterwards erected in Viti Levu on the banks of the Rewa and Navua rivers, and at Penang. Mills were also established in several of the smaller Islands. Only three Companies survived the depression of the 1880's, namely, the Fiji Sugar Company at Navua, the Penang Company on the Ra coast, and the Colonial Sugar Company at Nausori and Rarawai. The mill at Navua subsequently changed hands but was eventually closed down in 1922. The Penang mill also changed hands ; was closed down in 1922 ; re-opened in 1925 and was finally bought by the Colonial Sugar Refining Company in 1926.

The Colonial Sugar Refining Company

The Colonial Sugar Refining Company was established in Australia in 1855 but its connection with Fiji was not commenced until 1880 when it began the development of a mill and plantations at Nausori on the Rewa river. In 1883 the Company erected a mill at Rarawai, on the "dry" side of Vitu Levu to serve the Ba river district. The Company undertook no further development until 1894 when it erected a mill at Labasa on the "dry" side of Vanua Levu. Lautôka, the largest of the Company's five mills in Fiji, first crushed in 1903. The Penang mill was purchased in 1926.

The manufacture of sugar in Fiji is now entirely in the hands of the Colonial Sugar Refining Company. Three of the four mills in Viti Levu, namely Lautoka, Rarawai and Penang, and the one mill in Vanua Levu, namely Labasa, draw their cane supply from the leeward or "dry" zones. The mill at Nausori is exceptional in that it is the only one which has survived on the windward or "wet" side of Viti Levu, and its results are consistently inferior to those obtained at the other mills.

In addition to its sugar mills and Estates, the Company has embarked on a pine-apple industry—the development of which was interrupted by the war—and a cattle ranch. These investments in Fiji, however, represent only a minor interest of the Company, its main activities being located in Australia. The Company refines and markets 95 per cent. of Australia's domestic sugar requirements, and also markets the exportable surplus of Australian raw sugar. It owns four raw sugar mills in Queensland and three in New South Wales. Its refinery in Auckland is sufficient for New Zealand's requirements. The Company has two molasses distilleries in Sydney and Melbourne producing industrial alcohol.

The Company has a large Building Materials Division which manufactures and markets caneite, gypsum plaster and various asbestos products. It owns three ocean-going vessels designed to carry molasses in bulk.

In addition to these activities which the Company wholly owns, it has assisted the Australian Government during the war by constructing and operating various munition and other war material factories.

The Central organization of the Company is located in Sydney. The Company maintains a large and highly qualified technical staff of engineers, chemists and agriculturists with an unusual width of experience. A large modern research laboratory is maintained in Sydney, a pathological and disease laboratory for cane at Broadwater in New South Wales, and cane-breeding stations at Macknade in Queensland and at Rarawai in Fiji.

The geographical distribution and varied nature of its enterprises have endowed the Company with a measure of financial stability which has been of the utmost importance in the development and maintenance of the sugar industry in Fiji. The strength of its technical sections has enabled the Company to attain a high standard of efficiency at its sugar mills in Fiji.

Indians

The early development of sugar, coconut, cotton and coffee plantations was undertaken with the aid of labourers from the Solomon Islands, the "Line" islands, and the New Hebrides. Some 8,500 such labourers were introduced into Fiji between 1860 and 1877, but the majority had returned to their homes by the end of 1877.

Indian immigrants were first brought to Fiji in 1879. These labourers were recruited directly by the Government of Fiji and allotted to estates under official supervision. Immigrants were required to serve a five year period of indenture

Note.—Fijian currency is used throughout this report except where otherwise expressly stated. £100 sterling = £110⅔ Fijian.

FIJI ISLANDS
0 5 10 20 30 40 50
STATUTE MILES
LEGEND
SUGAR MILLS
177°
178°
179°
180°
179°
178°
16°
17°
18°
19°
LAMBASA
VANUALEVU
RAMBI
TAVEUNI
YASAWA
YASAWA
NAVITI
WAYA
GROUP
RARAWAI
PENANG
LAUTOKA
MALOLO
VITILEVU
NAUSORI
MBENGGA
VATULELE
ONO
KANDAVU
LEVUKA
KORO
KORO
NAIRAI
NGAU
SEA
NAITAMBA
YATHATA
KANATHEA
VANUAMBALAVU
VATUVARA
MANGO
LAU
TUVUTHA
THITHIA
NAYAU
LAKEMBA
VANUAVATU
GROUP
MOALA
MOTHE
HAMUKAILAU
WANGAVA
KAMBARA
TOTOYA
FULANGA
ONGEALEVU

on an estate, and became entitled to a free return passage to India after a further period of five years' residence in the island. The immigration of labourers under the indenture system was terminated by the Government of India in 1916, and all remaining indentures were cancelled early in 1920. Between 1879 and 1916, over 60,000 Indians had been brought into Fiji under the indenture system. The majority (about two-thirds) of the immigrants did not exercise their right to repatriation, and elected to remain in Fiji.

The Indian population has increased rapidly from 40,286 in 1911 to 60,634 in 1921, to 85,002 in 1936 and to 109,488 (estimated) in 1943. Indians now constitute 45 per cent. of the total population and are only slightly inferior in number to Fijians. The Indians birth-rate is higher, and the death-rate very much lower, than those for Fijians, and it is probable that Indians will soon outnumber Fijians.

Fijians

The Company has endeavoured for many years and by various means, but with little success, to interest Fijians in the growing of cane. A centre was established on one of the Company's estates at Drasa in 1937 for the purpose of training selected Fijians youths in cane farming. The boys are given a four years' course in practical farming with the object of rendering each of them capable of cultivating a 10 to 12 acres farm. The Company provides housing, food, clothing, pocket money and also a weekly credit which accumulates during the course to provide a fund at the time of taking over a farm. The Company undertakes to lease land to the trainees. Fijians at present cultivate only 3 per cent. of the land under sugar-cane and the training school at Drasa was established too recently to have had any appreciable effect on the number of Fijians cane-farmers.

Cane Production

The evolution of the present cane-farming system was a gradual process in which three main but overlapping stages may be distinguished. During the first stage the Company itself produced practically all the sugar-cane with the aid of wage-paid labour. During the second stage, which lasted from about 1909 to 1920, the Company leased its estates to independent planters. During the same period a substantial body of contractors grew up. These contractors cultivate cane on land not under the control of the Company (*see* below). Most of the planters were former officers of the Company. The planters were largely dependent upon the annual influx of indentured immigrants from India for the maintenance of an adequate supply of labour, but the system of indentured immigration was terminated by the Government of India in 1916. The Company recognized that the plantation system could not be maintained indefinitely without the aid of indentured labourers, and as early as 1916 it began tentative experiments with various forms of peasant cultivation. The cancellation of all existing indentures at the beginning of 1920, and the concurrent collapse of the sugar market, resulted in many planters handing back their estates to the Company. The Company endeavoured to cultivate the increasing acreage of land reverting to its control by employing Fijian labourers, and by the use of labour-saving devices such as tractors, but the output of sugar fell rapidly, and efforts to evolve a suitable system of peasant cane-farming (the third stage) were intensified.

Cane Farming

Three systems designed to enable Indians to grow cugar-cane on their own account were tried out concurrently. These systems may be distinguished as the "Settlement Scheme", the "Indian Planter Scheme" and the "Cane Farming Scheme".

Settlement Scheme

The Settlement Scheme is of especial interest as an attempt to secure to small-holders the advantages of mechanical "labour-serving" equipment. Each Settlement consisted of an estate divided into four large blocks of equal size. When the Settlement had become established, the first block would be immature plant cane, the second would carry mature plant cane, the third first ratoons, and the fourth would be under "long" fallow. Each "settler" was assigned a plot of land within each of the four blocks. The Company ploughed the land, but the "settler" was responsible for all other operations. This interesting experiment, which, if successful, might have had far reaching consequences, not only in Fiji, but also in other sugar producing countries and in other industries, soon fell into disfavour with the Company for it was found impossible to persuade the "settlers" to keep to a reasonably uniform time-table in the various cultural operations; some "settlers" abandoned their plots; and disputes repeatedly arose cooncerning plot boundaries. This experiment was conducted in circumstances which must be considered unusually favourable, in that the Company maintains a large, and more experienced, field staff than is likely to obtain in most other countries. The failure of the experiment is to be regretted in the interests of all concerned, for it is improbable that the peasant cane-farmer will be able to compete in the long run with highly mechanised and scientifically controlled plantation industries; so great has the disparity in productivity per person become. Until recently, cane production in most countries was carried on by hand labour or animal-drawn implements, and in such circumstances the Fijian cane-farmer ranked high in efficiency.

Indian Planter Scheme

The Company endeavoured. simultaneously with the Settlement Scheme, to establish Indians as small planters on blocks of from 50 to 80 acres of land. The Indian planters, like the Company and the European planters, found it impossible to secure an adequate supply of labour and the scheme proved a failure.

Table 1

Development of Cane Farming—Areas Cultivated 1925-44

Year	Total Area Under Cultivation	Cultivated By							
		Company		European Planters		Indian and Fijian Tenants		Indian and Fijian Contractors	
		Acres	Percentage of Area	Acres	Percentage of Area	Acres	Percentage of Area	Acres	Percentage of Area
1925 ..	64,963	33,679	52	4,446	7	6,905	10	19,933	31
1926 ..	67,494	30,350	45	4,040	6	9,080	13	24,024	36
1927 ..	70,526	28,828	41	3,677	5	11,448	16	26,573	38
1928 ..	75,007	23,700	32	2,342	3	20,710	28	28,255	37
1929 ..	77,645	20,025	26	2,004	3	25,559	33	30,057	38
1930 ..	78,250	17,641	22	1,611	2	27,896	36	31,102	40
1931 ..	78,373	12,610	16	1,133	1	34,300	44	30,330	39
1932 ..	80,939	9,160	11	744	1	39,412	49	31,623	39
1933 ..	83,692	7,450	9	645	1	43,077	51	32,520	39
1934 ..	84,497	5,335	6	658	1	44,989	53	33,515	40
1935 ..	87,738	4,874	5	661	1	45,690	52	36,513	42
1936 ..	89,924	4,532	5	653	1	46,031	51	38,708	43
1937 ..	91,197	4,500	5	717	1	46,139	50	39,841	44
1938 ...	91,475	3,219	4	369	—	47,405	52	40,482	44
1939 ..	91,812	3,126	3	240	—	47,421	52	41,025	45
1940 ..	91,624	3,111	3	206	—	47,268	52	41,039	45
1941 ..	92,628	3,153	3	161	—	46,521	50	42,793	47
1942 ..	94,046	3,119	3	221	—	46,439	50	44,267	47
1943 ..	90,913	2,728	3	197	—	45,383	50	42,605	47
1944 ..	89,059	2,425	3	197	—	45,332	51	41,105	46

N.B.—(1) Penang Mill figures are included from 1928 onwards.
(2) The decline in areas cultivated since 1942 is due to resumption of land for military purposes.
(3) Records are not available for years prior to 1925.

Cane-Farming Scheme

The Company had divided some of its estates into small farms which were leased to individuals. The experience of the Company as a grower of cane indicated that the typical Indian family could cultivate about 10 or 12 acres of cane land without the aid of hired labour. The farm is cropped on what is locally known as the "25 per cent. rotation" system. The farm is divided into four equal parts, one of which is planted in cane each year. Hence, during each crop season, one quarter of the farm is under immature plant cane, another quarter is under plant cane ready for harvesting, another is under first ratoons ready for harvesting, and the remaining quarter is under fallow. This system proved so successful from its inception as to persuade the Company to concentrate on its extension. The rapidity with which the Company split up its estates into small farms between 1924 and 1933 is shown in Table 1.

Tenants and Contractors

Those farmers who rent land from the Company are known locally as "tenants", to distinguish them from the "contractors" who produce sugar-cane on land not under control of the Company. An appreciable body of contractors had grown up during the period when most of the sugar-cane was produced by either the Company or

Table 2

Size of Farms in 1944

Acres	Number of	
	Tenants	Contractors
Up to 1.9	nil	141
2 to 3.9	22	640
4 to 5.9	105	711
6 to 7.9	114	440
8 to 9.9	595	373
10 to 11.9	1,502	378
12 to 13.9	960	238
14 to 15.9	440	214
16 to 17.9	189	132
18 to 19.9	41	82
20 to 21.9	24	101
22 to 23.9	6	67
24 to 25.9	2	70
26 to 27.9	2	51
28 to 29.9	1	39
30 to 39.9	3	99
40 to 49.9	4	48
50 to 59.9	2	19
60 to 69.9	nil	11
70 to 79.9	nil	6
80 to 89.9	nil	3
90.0 or over	nil	4
Total	4,012	3,867

European planters. In 1925, for example, contractors cultivated 31 per cent. of the total area under sugar-cane. By 1937 contractors had expanded their share of the total cane area to 44 per cent. Today, tenants and contractors account for 97 per cent. of the land cultivated in sugar-cane, and the Company retains only a small area for the purposes of training its field officers, demonstrating methods of cultivation, and providing a reserve of "seed-cane". Tenants now number 4,012 and contractors, 3,867 (Table 2).

The Company can require its tenants to practise a particular system of "rotation" and certain methods of cultivation, but it is limited to persuasion in the case of contractors. Some contractors with small farms plant the entire area in cane during one year, reap plant cane in the second year, and first ratoons in the third year. Such contractors have no cane to reap during one year in the cycle, and this accounts partly for the relatively large numbers of contractors marketing no cane even in "normal" years (Table 3). Other contractors reap two ratoons and replant later in the same year. Many contractors are compelled by heavy indebtedness to crop their land intensively and without adequate regard to the maintenance of its fertility.

Capital

Practically all the tenants and most of the contractors possessed no capital when they originally commenced working their farms. The tenants took over their farms on a valuation of the assets—in most cases cane only—the cost being debited to them in the Company's books. They were advanced money for the purchase of implements and livestock, and for subsistence. Many of the contractors similarly depended on the Company for finance, but some obtained capital from other sources.

Methods of Cultivation

When the Company decided to lease its lands to planters it inaugurated a series of experiments designed to ascertain the most efficient method of producing heavy crops of cane consistent with the maintenance or enhancement of soil fertility. These experiments were commenced at Rarawai in 1904. The "25 per cent. rotation" is the system generally recommended to farmers.

Ploughing.—The heavier operations such as ploughing out cane stools, burying cane trash and ploughing in heavy crops of green manure are generally done by disc plough. The disc plough is an expensive implement costing more than a small farmer can afford. The Company maintains nearly 500 single disc ploughs of the type known as D.1, which are available for hire by farmers at the rate of 1/- per day. A disc plough requires 4 bullocks or 4 horses to pull it, but most farmers own only 2 bullocks or 2 horses, and neighbours usually pool their livestock for the purpose of deep ploughing. Lighter work, such as cross-ploughing, and ploughing-in light green manure crops, is frequently done by mould-board ploughs. Most farmers own a mould-board plough which can be drawn by 2 bullocks or horses.

Drilling.—Some farmers use double mould-board ploughs, drawn by 2 horses, for drilling. Such drill ploughs can be hired from the Company at the Nausori, Labasa and Lautoka mills. Most farmers, however, use their own single mould-board plough, traversing the land twice for each drill.

Inter-row Cultivation.—The pony plough, a 7-inch mould-board implement drawn by a single horse, is the most widely used for inter-row cultivaion. Pony ploughing should be followed by scarifying, but this practice is not as general as it should be. The Cotton King is a 2-horse implement working 4 discs on each side of the cane row. Weeding between the cane plants in the row, as contrasted with weeding between the rows of cane, is done by hand, with either the hoe or the cane-knife.

Ratooning.—The trash left on the ground after reaping plant canes is burnt in order to destroy beetles sheltering in the trash and borer grubs contained in discarded portions of cane stalks. Inter-row cultivation is carried out with pony ploughs and scarifiers in the same manner as for the plant crop. The trash from the ratoon crop is ploughed in.

Drainage.—The Company has been responsible for the construction of the main drainage system. This system includes several miles of sea-walls with flood gates. In some areas, groups of growers are organised to clear and deepen main drains under the supervision of the Company's field officer. Individuals performing this work are remunerated and the cost is charged to the farmers concerned. Subsidiary drains within the individual farm are usually kept in order by the farmer himself.

Roguing.—The removal of stools affected by Fiji and Mosaic diseases, is carried out by roguing gangs organized by the Company's field officers. The expenses of this roguing are charged to growers on an acreage basis.

Manuring.—Artificial fertilizers are normally imported by the Company and distributed to growers at cost price. The Company recommends the application of super-phosphate and sulphate of potash to fallow land on certain soil types when sowing the green manures. The rates of application per acre are:—(*a*) First class land—Nil. (*b*) Second class land—2½ cwt. of super-phosphate, ½ cwt. of sulphate of potash. (*c*) Third class land—3 cwt. of super-phosphate, 1 cwt. of sulphate of potash.

The application of sulphate of ammonia is not considered necessary for first class, and some second class, land on which a good crop of green manure has been ploughed in. An application of 1 cwt. of sulphate of ammonia per acre is recommended for plant cane on third class, and some second class, land. Applications up to 3 cwt. of sulphate of ammonia are recommended for ratoons on first class land, and at a rate of 2 cwt. per acre on other land.

Table 3

Proceeds of Cane Crops, 1938, 1942, 1943

(Including Sale of Seed Cane)

Proceeds Per Farmer	Tenants		Contractors		Tenants with Contractors' Areas	
	No.	Aggregate gross proceeds of cane crop	No.	Aggregate gross proceeds of cane crop	No.	Aggregate gross proceeds of cane crop
1938						
		£		£		£
Nil	102	—	717	—	5	—
Up to £50	478	16,922	1,686	42,934	3	102
£51 to £75	818	52,802	546	34,108	2	126
£76 to £100	1,161	102,202	434	38,072	5	441
£101 to £125	790	88,325	295	33,016	9	1,021
£126 to £150	428	58,274	214	29,256	14	1,970
Over £150	354	63,129	554	138,952	33	10,284
Total number cutting	4,029	381,654	3,729	316,338	66	13,944
Average per grower excluding "Nil" group	—	£95		£85		£211
1942						
		£		£		£
Nil	117	—	632	—	3	—
Up to £50	159	5,234	1,390	35,093	3	118
£51 to £75	285	18,158	520	31,708	—	—
£76 to £100	485	42,936	347	30,043	3	253
£101 to £125	697	78,838	291	32,331	10	1,132
£126 to £150	671	92,086	265	35,849	12	1,685
Over £150	1,500	298,953	850	228,414	84	26,883
Total number cutting	3,797	536,205	3,663	393,438	112	30,071
Average per grower excluding "Nil" group	—	£141		£107		£268
1943 (Estimated)						
£		£		£		£
Nil	1,473	—	1,916	—	20	—
Up to £50	342	9,686	815	20,838	3	116
£51 to £75	316	20,028	326	20,333	1	75
£76 to £100	380	33,603	226	19,807	4	350
£101 to £125	446	50,322	164	18,255	5	561
£126 to £150	300	41,178	116	15,986	5	695
Over £150	663	113,363	355	92,630	42	11,893
Total number cutting	2,447	288,180	2,002	187,849	60	13,690
Average per grower excluding "Nil" group		£118		£94		£228

Note.—A large proportion of the growers in the lower grades of proceeds have other sources of income.

The Company supplied farmers with nearly 1,000 tons of sulphate of ammonia and nearly 500 tons of super-phosphate in 1939, but by 1941 further supplies were unobtainable. The farmers applied artificial fertilizers in the early days primarily because they were required to do so by the Company, but the experience of having to do without fertilizers

during the past few years appears to have convinced farmers that inorganic manuring is profitable. Surveys conducted in the West Indies* similarly show that peasants have no prejudice against the use of artificial fertilizers and that the main obstacle to their more extended use is the lack of cash or credit at the time when they should be purchased and applied. That peasants readily avail themselves of the offer of artificial fertilizers on credit has been demonstrated among cane-farmers in Trinidad, and peasants on Government land settlements in Antigua.

Coral Sand.—The Company encourages the periodic application of coral sand at the rate of about 5 tons per acre to all land except rich alluvial soils It is procured by the Company and delivered to or near the farm in bags each containing 75 lb. of coral sand, this weight being convenient for handling by farmers when spreading in the field. Supplies of coral sand are normally available to farmers in the Nausori, Rarawai, Labasa and Lautoka mill areas but there is no satisfactory source of supply near the cane lands serving the Penang mill. The shortage of labour, the use of dredges for military purposes, and the use of the transportation system for military supplies have seriously restricted the quantity of coral sand available for distribution to farmers since 1941. Between 3,000 to 6,000 acres yearly were treated with coral sand between 1937 and 1942.

Mill Mud.—Mill mud, applied at the rate of 15 to 20 tons per acre, has been shown to give increased yields of cane, and it has been extensively used to improve the fertility of the poorer soils. Between 800 to 1,300 acres of cane land a year are treated with mill mud. Mill mud consists of materials discarded from the factories, the most important part being the filter press mud which is rich in nitrogen, phosphoric acid and lime.

Green Manuring.—Green manuring crops are used during the long fallow period to smother weeds, to protect the land from erosion and to provide nitrogen for the young plant cane. The Company has experimented with many different legumes and has found Mauritius bean (*Stizolobium nivea*) the most satisfactory. There has been increasing reluctance on the part of the farmers to plant Mauritius bean because it provides no food or cash return. Many Indians prefer cowpeas (*Vigna unguiculata* L.), or, in some districts, dhall (*Cajanus cajan* millsp.). both of which are food crops. The reluctance of the farmer to cultivate a crop which produces no direct return in food or cash is understandable but regrettable.

Farmyard Manuring.—The most striking defect of the present system of farming is the failure of the farmer to manufacture and apply farmyard manure. The number of cattle units maintained by the farmers is not known, but the majority of those visited owned a pair of bullocks or horses, and a cow. In some cases the animals are brought to a small paddock, or housed in a shed, on the homestead. On none of the farms visited, however, was there any attempt to manufacture farmyard manure. A farmer could manufacture about 5 tons of farmyard manure from each cattle unit he maintains, and the typical farmer, therefore, should be able to produce 15 or more tons of farmyard manure per annum. There is urgent need of experimentation in methods of mixed farming (*i.e.* the complementary use of crops and livestock) for peasant cane farmers. Surveys of peasant agriculture in the British West Indies suggest that one of the biggest obstacles to the adoption of mixed-farming is a physical one, namely, the problem of transporting bulky farmyard manure from the place where the animals are maintained to the plots of land, for most West Indian peasants have their holdings made up of two or more plots and frequently at considerable distance from their homes. But even where the West Indian peasant lives on an undivided holding and keeps his animals there he does not produce and apply farmyard manure systematically. He is not convinced that the extra labour required for the production and application of farmyard manure is adequately compensated for in increased yields. It is therefore necessary to prove by experiment and trial that farmyard manuring is profitable. Once that proof has been demonstrated it will become relatively simple to persuade the peasant to adopt the practice.

Agricultural Shows.—The Company normally holds an annual agricultural show and competition in each of the mill areas, at which prizes and certificates are given for the "best farm", ploughing, livestock, etc. The last shows were held in 1941 but it is the intention of the Company to resume these shows in the near future. Doubt has been expressed as to the value of these shows on the grounds that the prizes are shared year after year by a small number of farmers. The more enterprising farmers merit encouragement, and the possession of certificates is a source of pleasure and pride to them. The "best farm" competition affords a convenient means of introducing new practices, and it is suggested, for example, that the adoption of mixed farming should be made an essential qualification for competitors.

Field Officers.—The Company employs a large staff of field officers who maintain direct contact with individual farmers. Each mill area has been divided into districts, which in turn, are subdivided into sectors. A senior officer is in charge of each district, and under him a field officer is in charge of each sector. A sector is an area occupied by between 100 and 200 farmers. The field officer is responsible for deciding the variety of cane to be grown on the various farms, inspecting the cultivation, maintaining the main drainage system, roguing out diseased cane, arranging cash advances for the farmers, providing supplies of coral sand, mill mud, fertilizers, etc., organizing the cane-cutting gangs, paying out the proceeds

*(a) Peasant Agriculture in the Leeward and Winward Islands, by C. Y. Shephard pp. 211 (Cyclotyped memorandum). (b) Peasant Farming in the Bejucal Area of Trinidad, by A. L. Jolly, *Tropical Agriculture, Trinidad*, 22: 83-88, 1945.

of cane, and generally acting as the guide, philosopher and friend of the farmers in his sector. The control exercised by the field officer during the years when labourers were being trained to be cane farmers had to be strict, and the successful establishment of the present intricate and highly organized system of cane-farming is a tribute to both field officers and farmers. There is now a tendency among some farmers to chafe under what they consider certain restrictions of their liberty, but it is noteworthy that personal relations between farmers and field officers have remained generally cordial. The time is far distant when the farmers will be sufficiently highly organised to dispense with the assistance and guidance of the field officers.

Harvesting Sugar-cane

The intricate but highly efficient system employed in the harvesting of cane is one of the most interesting features of the industry. Harvesting is not conducted by the individual, but by groups of farmers living adjacent to one another. The farmers meet the Company's field officer shortly before the commencement of crop and sign an agreement binding themselves, under penalty of forfeiture of a bond, to serve as cutters themselves, or to supply substitute cane cutters, until the cane of the whole group has been harvested. The number of farmers in a group varies, according to geographical convenience, from 30 to 80. Each signatory of the agreement undertakes to provide one cutter throughout the cutting season for every 6 acres of his own mature cane, and extra cutters *pro rata* for additional areas. The typical cane-grower with a 10 or 12 acre farm, normally has 5 or 6 acres of cane to cut.

The work of the gang is supervised by a sirdar elected by the members. The order in which farms are cut is decided by the Company's field officer. The Company delivers portable line, and an appropriate number of cane trucks, to the point on the permanent tramway nearest the farm. Certain members of the gang, known as "line boys", lay the portable line from the permanent tramway into the cane field, and arrange for empty cane trucks to be hauled to points near the cutters. The cutters work in pairs to cut the cane and load it into the truck. Each truck is identified by a number. The cane is weighed at the mill, and the weight of cane in each truck is communicated to the sirdar who records the wages due to the individual cutter.

The payment for cutting and loading the cane varies accordingly to the yield per acre, *e.g.* if the block yields at the rate of 20 or more tons per acre wages are calculated at the rate of 1s. 3d. for each ton of cane cut. If the yield is at least 16, but less than 20, tons per acre, payment to cutters is made at the rate of 1s. 4d. per ton. The wage rate rises to 2s. 2d. per ton when the yield is less than 10 tons per acre. A bonus of up to 3d. per ton of cane may be paid for certain varieties of cane (*e.g.*, H. 109) which have a recumbent habit of growth. The calculation of the wages due to the individual member of the gang may appear a complicated process but has been simplified by the use of a "ready reckoner". An output bonus is paid to any cutter who earns more than 2s. 6d. on any day, the bonus being equivalent to half the sum by which the earnings exceed 2s. 6d. on that day, but subject to a maximum bonus of 1s. 3d.

The pay list is made up by the gang sirdar and is checked by the Company's field officer. The Company advances the amounts required for the fortnightly payment of members of the gang, charges the payments against the individuals whose cane has been cut, and recovers the amounts from the proceeds of the cane.

The typical individual farmer who himself serves as a member of a gang can recover in wages received for cutting his neighbour's cane approximately the same amount as he spends on having his own cane cut. In such circumstances the rate paid for cutting cane is of little consequence, but it has become customary for nearly half the growers in Viti Levu, and a smaller proportion in Vanua Levu, to hire substitutes for service in the gang. The substitute is paid a bonus of £10 or £15 at the end of the crop, in addition to his daily wages. The employment of substitutes may be unavoidable for large farmers, and for small farmers in feeble health, but the "substitute" is a luxury to the typical farmer.

The responsibility for supplying a sufficient number of working bullocks for hauling trucks of cane from the field along the portable line to the permanent way lies with the farmer whose cane is being cut. The "line boys" are in charge of this part of the haulage. The Company undertakes the haulage of cane along the permanent way to the mill. When cutting on one farm is completed the portable lines are laid on to the next farm, and so on until one group of farms is completed when the lines are lifted and relaid into another group of farms.

Both the Company and the farmers are to be congratulated on this highly efficient method of harvesting cane. This orderly system is vastly superior to that with which I am familiar in Trinidad where each cane-farmer cuts and carts his own cane, and may have to spend most of the day in idleness awaiting his turn at the purchasing scale. The long queues to be seen at every purchasing scale in Trinidad during the cane crushing season are evidence of an enormous waste of man- and animal-power which is happily avoided by the admirable co-operative system employed in Fiji.

The amount of sugar-cane which the Trinidad cane-farmer can cut and cart determines in large measure the amount of cane he can produce. The gang system in Fiji enables the farmer to market a much larger quantity of cane than can the Trinidad farmer. The co-operative harvesting system, coupled with the fact that most of the cultivation is performed with animal-drawn implements, enables the typical Indian family in Fiji to cultivate 10 or 12 acres in sugar-cane. The typical Indian family in Trinidad, where all

the cultivation is done by hand, and where the carting of cane is chaotic, can cultivate only about 5 acres of cane land.

Sugar-cane Varieties

There are many thousands of varieties of sugar-cane which differ from one another in colour, thickness, length of joints, shape of the stalk or the eyes, habit of growth, number of stalks to a stool, and in many other less striking characters. The problem of selecting the most suitable variety is by no means a simple one. Prominent consideration must be given to yields, both as plant and ratoon cane, to sugar content, and to resistance to pests and diseases. The choice of varieties is complicated in Fiji by a wide range of soils and climate. Consequently, it is customary to find two or more varieties grown in a single mill area but on different soil types. Other mill areas may have a different set of varieties. When a variety proves susceptible to some disease or pest it must be replaced as rapidly as possible by a more resistant variety. Similarly, the old standard varieties give way to new ones of proved superiority. Hence, the varieties grown to-day may differ entirely from those grown twenty years ago.

The Company has made the introduction and breeding of cane varieties a prominent feature of its work. A cane-breeding station has been maintained at Rarawai since 1904. This station is associated with others maintained by the Company in Queensland and New South Wales. Many cane varieties have been introduced into Fiji both from the Company's own stations in Australia, and also from Hawaii, Java, the West Indies, and other parts of the world. These varieties are tested in different environments in Fiji, and supplies of the best ones are built up for distribution to growers. The Company has maintained stations at most of its mills for the purpose of testing cane varieties, but an increasing number of these variety trials has been carried out on selected Indian farms on account of the reduction in the area cultivated by the Company, and the relatively narrow range of conditions which it represents.

Introduced Varieties.—The most outstanding of the introduced canes is Badila, a New Guinea cane brought from Queensland in 1902. Badila is a very high sugar-yielding variety and is widely grown on the better soils. It constitutes the dominant variety on areas serving the Lautoka and Penang mills, and is one of the major varieties at each of the other mills. H. 109, a Honolulu seedling brought from Hawaii in 1911, constitutes the principal variety at Labasa. P.O.J.2878, a Javan seedling, was introduced via Sydney in 1928. Appreciable areas of P.O.J.2878 are grown in the Penang and Labasa districts, and to a smaller relative extent in the Lautoka area. Malabar (or Yellow Caledonia) accounted for 96 per cent. of the total area under cane at Nausori in 1932, and although it has been replaced to a large extent by Argus and Badila, it still remains the most suitable variety for land which is difficult to drain.

Fijian Seedlings.—The Company has raised over 75,000 seedlings in Fiji during the past 40 years. Several of these seedlings have shown outstanding merit. Pompey, which was raised in 1907, is extensively grown on poor land in the dry zone, notably in the Rarawai area, where it is the principal variety. Argus, raised in 1918, is grown in the wet zone at Nausori on land which is not fertile enough to grow good crops of Badila. Ajax, a 1922 seedling, is tending to replace Pompey on poor land in the dry zone. Other seedlings such as Galba, Corvus, Pluto, Marcus, 24R-2771, all of which were bred at Rarawai, are grown in smaller proportions in various districts.

Cane breeding continues despite the war, though on a reduced scale. The results of this varietal work have been an improvement in the tonnage of cane per acre, and, in some districts, a marked improvement in the yield of sugar per ton of cane.

Pests and Diseases. — The prevention of excessive loss of cane from pests and diseases is one of the most important obligations the Company has assumed, and the primary method of control is the selection of resistant varieties of cane.

Diseases.—Many diseases of sugar-cane are known in Fiij, but only three of them are at present considered potentially serious dangers. The most imporant is a virus disease known as Fiji disease, which at one time caused serious losses of cane in the Nadi district. This disease has been brought under control by reducing the number of ratoons to one, planting a green-manure crop between periods of cane cultivation, regular inspections of the young cane in the field for the purpose of destroyng diseased stools (roguing), the selection of healthy planting material and the selection of resistant varieties of cane. "Leaf scald" (*Bacterium aibillneans*) and "downy mildew" (*Solerospora sacchari*) are also important diseases which have been kept in check by the Company's control measures. P.O.J.2878 is susceptible to downy mildew and is losing favour on that account.

Pests.—There are many pests which cause a small amount of injury to cane in Fiji, but only one, the beetle borer (*Rhabdocnemia obscura*), is of great importance. The beetle borer causes the loss of thousands of tons of cane every year, especially in the soft varieties of cane, such as Badila. The tachinid fly (*Ceromasia sphenophori*) is an effective parasite of the beetle borer, and the Company has made persistent efforts for many years to establish this parasite in Fiji, but, although it is present in small numbers, it does not give a satisfactory measure of control. Burning of plant trash, the immediate ploughing in of ratoon stumps and trash, good drainage and the use of borer-free planting material assist to keep the borer in check. The substitution of H.109, a relatively hard rind variety, for the much softer Badila, has considerably reduced the damage caused by borer in the Labasa mill area.

(*To be concluded.*)

CHEMICAL NOTES

(Compiled by the College Department of Chemistry and Soil Science)

Defoliants

The 1945 season saw an extension of the new practice of dusting cotton fields shortly before harvest with a compound, of which calcium cyanamide is the active ingredient, to get rid of the leaves. The chemical in combination with dew kills the leaves and the plant casts them off in the course of a few days. The damage, however, does not extend by translocation to the plant stem and roots because the chemical is unstable and presently becomes harmless by reason of a further reaction. The denuded cotton plant continues to thrive, the cotton bolls, thus uncovered to the sun, ripen better and more uniformly and it becomes feasible to harvest the crop by a single picking instead of the usual two or three. Hand laborers strip nearly twice as much cotton per day from such treated fields.

Cotton sets its earliest and best bolls on the lower branches of the plants and in wet years the foliage is often so luxuriant that these early bolls deprived of air circulation and sunlight, stay wet and the fiber rots, with losses as high as 50 to 60 per cent. of the crop. Defoliation averts this.

Defoliating is due to become more important when machines for harvesting cotton become generally available, for the leaves are often very dense, clogging the machines and staining the cotton, whereas the machines work swiftly and well on defoliated plants. If machine harvesting is delayed until frost removes the leaves, there may be weather damage to opened bolls and loss of grade. Picking costs are a serious factor in American cotton raising and their reduction may mean much to the ability of American growers to compete with the low-paid labor of Egypt and the Orient in the markets of the world.

When army worms start to infest a cotton field, defoliation robs them of their food and they do not multiply and foul the cotton. Early harvesting is facilitated in certain districts where necessary to win the race with the pink boll worm. Fertilizers stimulate growth of both cotton fiber and leaves but may be more boldly used now that excessive foliage can be so easily disposed of.

Success of defoliation with cotton has led during the past year to its trial with other crops. Soybeans, now increasing in demand, benefit by such control. The highest yielding varieties mature so late that winter grain cannot be sown to the best advantage after the soybean harvest, yet soybean land should not be left bare over winter. Defoliation any time after the seeds lose their green color, causes rapid loss of moisture without reduction of yield or quality, and gets the seeds dry enough for harvesting at the early-crop premium prices. Early harvesting also averts losses that occur when plants are beaten down so low by late autumn storms that harvesting machinery cannot garner them; such losses sometimes amount to 20 or 30 per cent. of the crop. Defoliated plants go through the combines fast and easily. (Abstracted from *For Instance*, American Cyanamid Company, No. 19, 1946).

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Tree Decline in Avocado Orchards

Definite correlations were established between the accumulation of free water in the soil and the occurrence of avocado decline. In some cases surface drainage from adjacent land had occurred, in others water had accumulated on the surface near the top of rounded hills, and again in some cases of decline the trees were found to have been planted in holes blasted about 5 feet deep and in these clay had formed an impermeable layer. All measures whereby stagnant water is eliminated help to prevent decline.—(Abstr. 1220 in *Hort. Abstr.*, **15**, from *Yearb. Calif. Avocado Soc.* 1943, 1944, 34-7.)

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Avocado Decline Investigations

The research programme already initiated by the Agricultural Experiment Station at Los Angeles is divided into five parts:—(1) Drainage and soil moisture trials. (2) Possible relations between soil organisms and tree decline. (3) Field survey, including rootstocks. (4) Possibility of oxygen deficiency in soil and decline. (5) Soil-water relations survey in San Diego County. The beginning of the work on these different projects is noted.—(*Abstr.* 1223 in *Hort. Abstr.*, **15**, from *Yearb. Calif. Avocado Soc.* 1944, 1945, 24-7).

* * *

Value of Bulky Organic Manures

Experiments carried out by the Scientific Department, Tocklai Experimental Station, with bulky organic manures show that their nitrogen is much less efficient, unit for unit, than that of inorganic manure such as sulphate of ammonia. The efficiency compared with inorganic manure as 100 per cent. was :—

At Allynugger : Indore compost 43 per cent., Dacca compost 48 per cent., the unfermented materials used for making Dacca compost 68 per cent., animal meal 83 per cent. At Champarai : compost 58 per cent., and at Gandrapara 40 per cent. However, the effect of bulk organic manures may be so much reduced under shade as to render them almost valueless.

Manufacturing experiments have shown that an increase in total nitrogen content of the leaf results in a lowering of the quality of the made tea. The increase in nitrogen content of the plucked shoot is proportional (a linear function) to the increase in nitrogen supplied as manure. —*Ann. Rept. Tocklai Expt. St.*, 1944).